

**Progress Report No. 1 (November 1, 2000 to June 30, 2001)**

# **Temperature Variation in Drilled Shaft Concrete and its Effect on Slump Loss**

**FDOT Contract No.: BC 836**

**FIU Project No.: 571852100**



**Principal Investigator: Irtishad Ahmad, PhD. PE.  
Florida International University  
Miami**

**Submitted to:**



**Florida Department of Transportation (FDOT)**

## **Review of Activities (November 01, 2000 to June 30, 2001)**

This interim report includes description and brief summary results of the activities completed during the first eight months of the project. The tasks that were undertaken: (1) Detailed literature review; (2) Feedback from the Department of Transportation (DOT) in other states on this problem; (3) Development of test models and protocol; and (4) Conduct first phase of tests to determine ground temperature variation along depth.

In the following, descriptions, brief results and status of each of the tasks are given:

### **Detailed Literature Review**

In the first phase of the project, a comprehensive search was made to collect all published or unpublished literature on this topic from the research journals, conference proceedings, special reports and personal notes. Concrete suppliers and contractors were also contacted during this stage. It was found that no literature is available on this topic and no input was received from the concrete researchers around the world (using different concrete mailing lists on the Internet).

### **Feedback from the Department of Transportation (DOT) in Other States**

E-mails were sent to the Department of Transportation in 26 other states, inquiring them about this issue and asking their feedback. It was found that none of the states have any particular specifications related with temperature variation in drilled shaft concrete. Most replies pointed out that the slump should be more than 230 mm at the start of casting and should not drop below 100 mm at any stage of casting the shaft.

### **Development of Test Models and Protocol**

After consultation with the project team, it was decided to conduct the field-testing in two phases as follows:

### **Phase I: Conduct exploratory tests**

The purpose of this phase is to determine the ground temperature variation along depth to investigate its impact on the slump loss. A great temperature variation could affect the slump while if there is no variation, then the slump may remain constant particularly when the effect of other factors like heat of hydration is small.

### **Phase II: Field and laboratory testing**

The field-testing will include the recording of temperature variation along the width and depth of drilled shafts. It was decided to drill four shaft of 4 feet diameter (two with casings and two without). The depth of the shaft will be decided on the basis of test results obtained from Phase I. The laboratory testing will be conducted to develop rate of slump loss curves at different temperatures as found in Phase I.

### **Phase 1: Conduct exploratory test to determine ground temperature variation along depth**

The site selected for this phase was the NE corner of the Engineering and Applied Sciences Building of the Florida International University (107 Ave. and Flagler Street). Universal Engineering was engaged to drill the holes and setup necessary instrumentation. Three holes were drilled up to 50 ft. depth and encased with a plastic casing. The temperature variation data was recorded on February 26, 2001 (Afternoon) and then repeated on March 01, 2001 (Morning). The following data were recorded.

- Temperature inside each hole at an interval of 2 ft up to a depth of 10 ft and then at an interval of 5 ft up to the full length of 50 ft. Each reading was recorded when the temperature stabilizes at that depth. The readings were taken in both ways i.e., going down and then coming up to avoid any experimental mistakes.

- Ambient temperature at the test-site.
- Ambient temperature in the city using hourly data from the Internet.

The results are shown in the attached Appendix and clearly indicate that the temperature stabilizes 1-2 feet below the water table. The average stabilizing depth was found to be 10 ft. It was noted that the temperature variation is not dependent on the atmospheric conditions. The test results suggest that slump should be determined at the underground temperature.

### **Future Activities Planned for the Next Quarter**

In a project team meeting held in FIU on June 27, 2001, it was decided to carryout the phase II of the project, which will include the following activities:

- Drilling of four (two with casings and two without) 4 feet diameter and 20 feet deep shafts to simulate the actual test conditions. The shafts will be drilled at the same site in FIU (as Phase I). The shafts will be reinforced to carry the temperature probes, which will be placed both along depth and width.
- Automatic temperature recorders will be used to record the probe temperatures at specified intervals.

The phase II will start at the end of August (depending on the hiring of the contractor) and expected to be completed within one month. Once phase II is finished, then the results will be analyzed and the plan for future field or laboratory experimentation will be decided.

### **Remaining activities**

Task 5: Second Phase of Experimentation

Task 6: Analyze Results

Task 7: Prepare Draft Final Report

Task 8: Review of Draft Final Report

***This report represents a percentage of completion for the project of 25%***

Table 1: Ground Temperature Variations

Date: February 26, 2001

Hole 1 (11:30 - 11:46)				Hole 2 (11:51-12:20)				Hole 3 (12:54-1:24)			
Depth	Temp (°C)		Rem	Depth	Temp (°C)		Rem	Depth	Temp (°C)		Rem
(ft)	Down	Up		(ft)	Down	Up		(ft)	Down	Up	
1.2	--	26.6		0.9	27.4			0.3	30.7		
3.2	--	24.3		2.9	26.8	24.7		2.3	29.6	24.3	
5.2	--	24.4		4.9	26.5	24.8		4.3	28.9	24.3	
7.2	--	24.5	WT = 6.37'	6.9	26.4	24.9	WT=6.42'	6.3	28.5	24.3	WT=6.38'
9.2	--	24.5		8.9	24.8	24.9		8.3	24.6	24.4	
14.2	--	24.5		13.9	24.6			13.3	24.2		
19.2	--	24.6		18.9	24.7	24.7		18.3	24.2	24.3	
24.2	--	24.7		23.9	24.9			23.3	24.5		
29.2	--	24.9		28.9	25.0	25.0		28.3	24.8	24.8	
34.2	--	24.9		33.9	25.0			33.3	24.9		
39.2	--	24.8		38.9	24.8	24.8		38.3	24.9	24.9	
44.2	--	24.7		43.9	24.7			43.3	24.7		
49.2	--	24.7		48.9	24.7	24.7		48.3	24.7	24.7	

**Ambient Temperature Readings from Internet**

10:00 AM 25.0C  
 11:00 AM 26.4C  
 12:00PM 27.2C  
 01:00PM 27.8C  
 02:00PM 27.2C

From Thermometer at Site = 24.4C at 11:45 AM

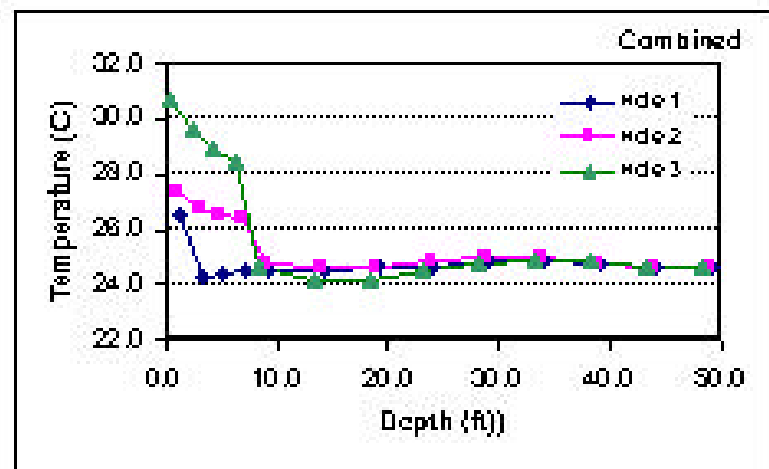
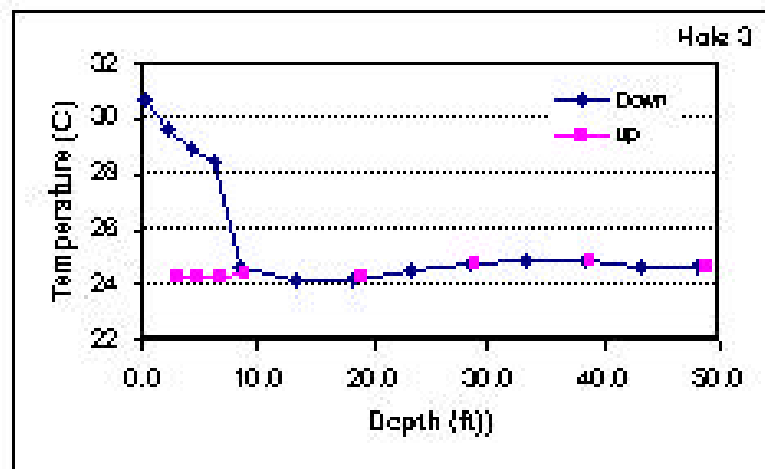
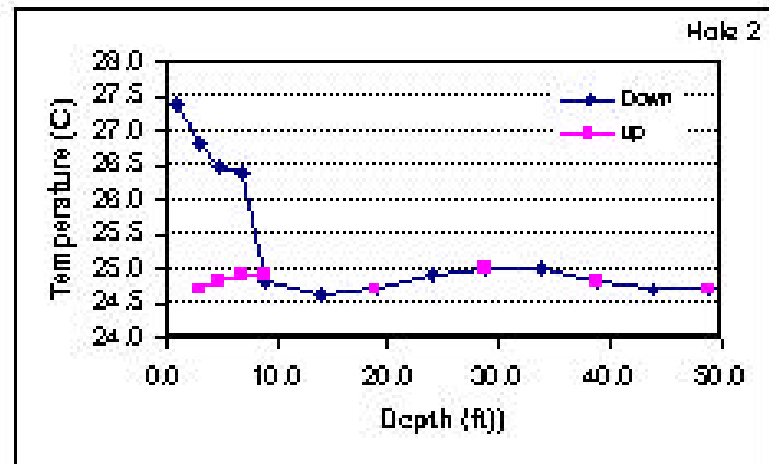
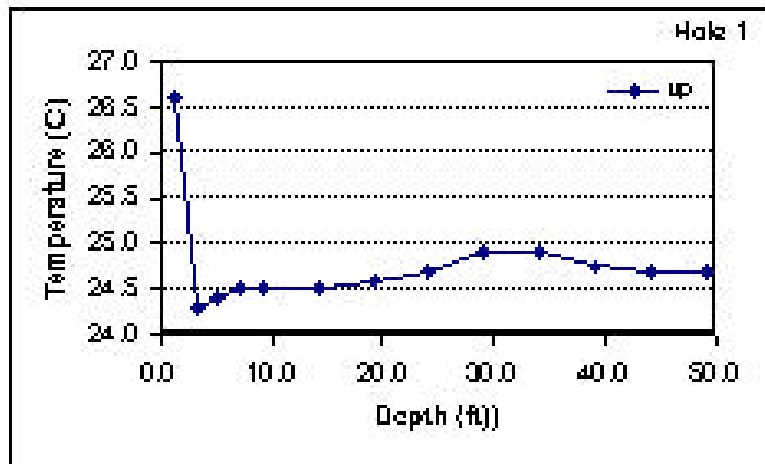


Fig. 1. Ground Temperature Variation on Feb. 26, 2001

Table 2: Ground Temperature Variation

Date: March 01, 2001

Hole 1 (08:38-09:11)				Hole 2 (09:30-09:51))				Hole 3 (10:00-10:20)			
Depth	Temp (°C)		Rem	Depth	Temp (°C)		Rem	Depth	Temp (°C)		Rem
(ft)	Down	Up		(ft)	Down	Up		(ft)	Down	Up	
1.2	27.4			0.9	28.0			0.3	25.4		
3.2	27.6	24.3		2.9	27.6	24.5		2.3	24.9	24.1	
5.2	27.6	24.3		4.9	27.2	24.5		4.3	24.7	24.1	
7.2	27.4	24.3	WT = 6.44'	6.9	26.9	24.6	WT=6.44'	6.3	24.6	24.1	WT=6.40'
9.2	24.5	24.3		8.9	24.9	24.6		8.3	24	24.1	
14.2	24.4			13.9	24.7			13.3	24.1		
19.2	24.5	24.5		18.9	24.7	24.7		18.3	24.2	24.3	
24.2	24.7			23.9	24.8			23.3	24.5		
29.2	24.8	24.8		28.9	24.9	24.9		28.3	24.7	24.8	
34.2	24.9			33.9	24.9			33.3	24.85		
39.2	24.7	24.7		38.9	24.7	24.7		38.3	24.85	24.8	
44.2	24.7			43.9	24.7			43.3	24.7		
49.2	24.6	24.6		48.9	24.7	24.7		48.3	24.6	24.6	

**Ambient Temperature Readings from Internet**

9:00 AM 21.6C  
 10:00 AM 23.9C  
 11:00PM 24.2C

From Thermometer at Site = 23.3 at 8:30 AM  
 From Thermometer at Site = 27.2 at 9:14 AM

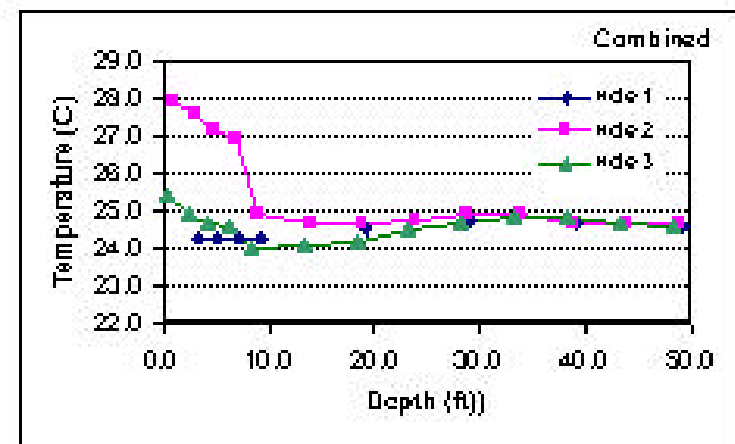
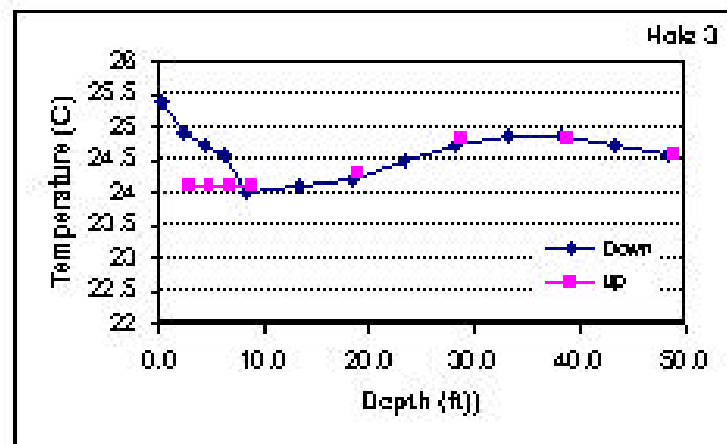
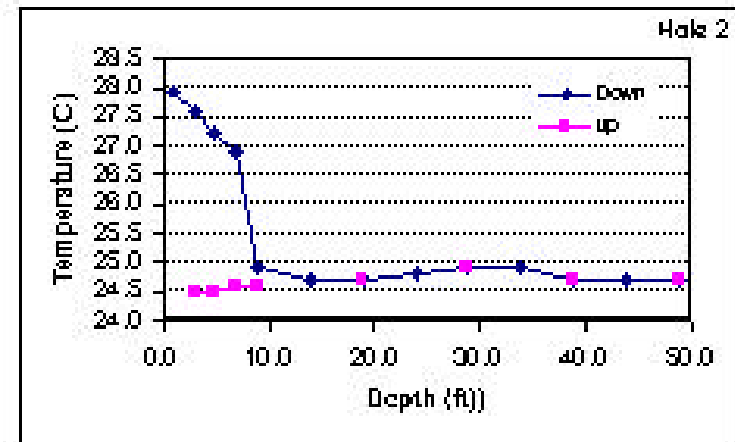
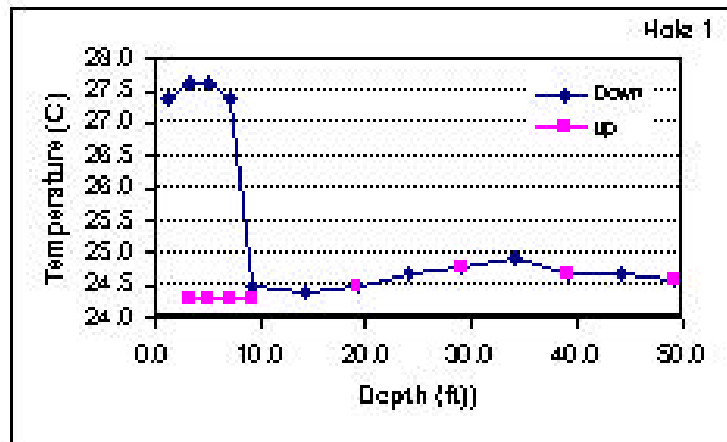


Fig. 2. Ground Temperature Variation on March 01, 2001



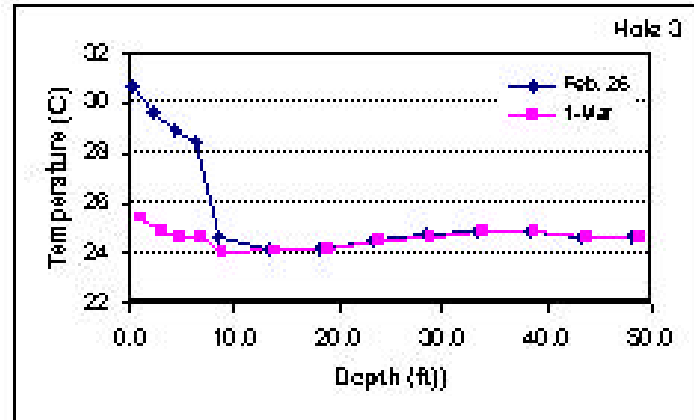
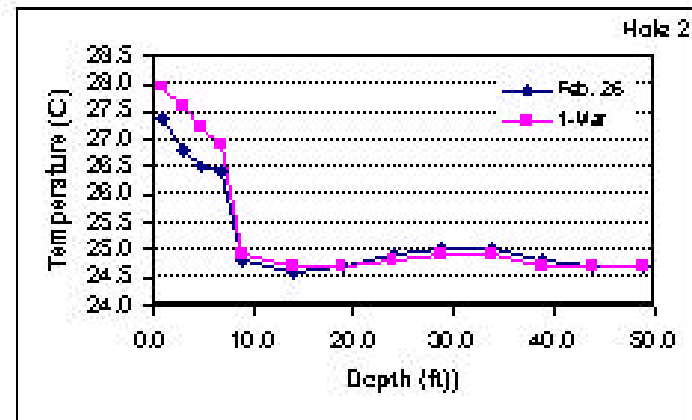
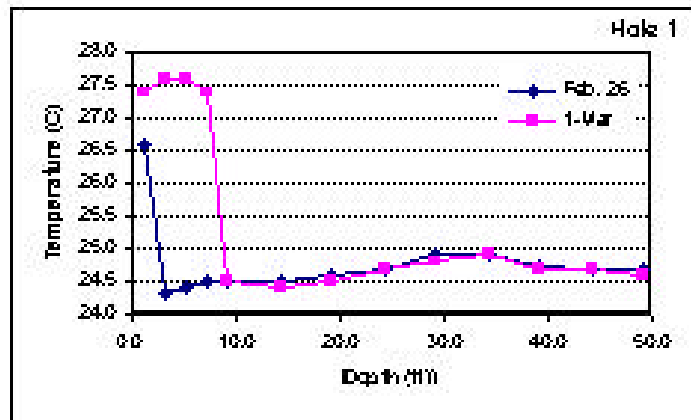


Fig. 3. Ground Temperature Variation (Combined Data)